



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/787,323	02/27/2004	Rod A. DeKoning	6502.0572	4325

60667 7590 11/30/2006

SUN MICROSYSTEMS/FINNEGAN, HENDERSON LLP
901 NEW YORK AVENUE, NW
WASHINGTON, DC 20001-4413

EXAMINER

SHELL, JOSEPH O

ART UNIT	PAPER NUMBER
----------	--------------

2114

DATE MAILED: 11/30/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/787,323	Applicant(s) DEKONING, ROD A.	
	Examiner Joseph Schell	Art Unit 2114	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 November 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-49 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 49 is/are allowed.
- 6) ☒ Claim(s) 1-48 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 June 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

Detailed Action

Claims 1-49 have been examined.

Claims 1-48 have been rejected.

Claim 49 is allowed.

Claim Objections

Claim 4 lines 3 and 5 should read "set of storage processors."

Claim 4 line 8 should read "the fifth communication fabric, and the second..."

Claims 8 and 9, lines 2 and 4 should read "set of storage processors."

Claim 10 line 7 should read "path including ~~the~~ at least the host system."

Claim 19 lines 2, 3, 5 and 7 should read "set of storage processors."

Claim 24 line 13 should read "traverses selected ~~selective ones of the~~ fabrics, storage processors, and storage devices."

Claim 41 lines 2-4 should read "set of storage processors."

Specification

1. In paragraph 7, line 3 should read "**these** methods."

In paragraph 8, the first sentence contains redundant use of "storage virtualization environment" and confuses the paragraph. Also in paragraph 8, line 6 has a forward slash where there should be a period.

Allowable Subject Matter

2. Claim 49 is allowed. The examiner deems the novel limitation to be the adjustment of a virtual volume affects virtual volume objects associated with the storage processors.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claim 47 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The claimed embodiment is a computer-readable medium, and the last paragraph of the specification states that such a medium could be a carrier wave or propagation medium. In order to be considered statutory, the invention needs to be claimed in such a way that it excludes non-material or intangible (propagation wave) embodiments.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 5-6, 20-23, 27-28, and 42-45 are rejected under 35 U.S.C. 112 second paragraph for being indefinite.

Generally, the claims describing the configuration of the controllers, fabrics, etc. describe a layout as shown in Applicant's Figure 10. Claims reciting failover routing assume additional communicative connections not cited in the parent claims' limitations or within the Figures. The discrepancies are detailed below.

5. As per claim 5, the first paragraph of the claim states that a communication path is configured to include the host system, the second communication fabric, and the first blade component. The parent claim 4 the first blade component is attached to the first communication fabric, while the second blade component is attached to the second communication fabric. Thus, unless the first and/or second fabrics are attached to both blades (which is unstated) the first blade component cannot be a part of a path using the second communication fabric. The examiner is assuming that line 3 of the claim should instead read "path including the host system, the first communication fabric, and the first blade component."

Also in claim 5, the second paragraph states that when the first blade component is inaccessible, a path is configured including the first blade component. Examiner is assuming the point of a configurable path is to configure around inaccessible components and thus the newly configured path instead includes the second blade component. This paragraph also includes the first communication fabric when the first component is inaccessible while the parent claim states that the first blade component is connected to the first communication fabric, it makes no mention of the first

Art Unit: 2114

communication being connected to anything other than the first blade component. The examiner is thus assuming that the last line of the claim should instead read "path including the host system, the second communication fabric, and the second blade component."

6. As per claim 6, the first two lines state that the fifth communication fabric is "including" a sixth and seventh communication fabrics. The last two lines of the claim then say that the sixth communication fabric is used with the fifth is unavailable. This is indefinite because, as stated earlier in the claim, the sixth fabric is part of the fifth fabric. A failover from the fifth to sixth fabrics is implausible. The examiner is assuming that the last two lines should instead read "include the sixth communication fabric when the seventh communication fabric is unavailable."

7. As per claim 20, this claim recites that a new path can be configured when the second port is unavailable that utilizes "any one of the third and fourth blade components" and the third communication fabric. Parent claim 19 only recites that the third blade is connected to the third communication fabric and that the fourth blade is connected to the fourth communication fabric. A path that goes through the fourth blade component and the third communication fabric lacks antecedent basis. The examiner is assuming that this path must traverse the third blade component (excluding the possibility of the fourth blade component) to reach the third communication fabric and the first port.

8. As per claim 21, similarly to claim 20, this claim recites that when the second port is unavailable the newly configured path can use the fourth blade component to reach the third communication fabric and the first port. This use of the fourth blade component lacks antecedent basis because, within the parent claim, the third communication fabric and the first port are only connected to the third blade component. The examiner is assuming that this new path must traverse the third blade component (excluding the possibility of the fourth blade component) to reach the third communication fabric and the first port.

9. As per claim 22, similarly to claim 20, this claim recites that a newly configured path can traverse the third or fourth blade components to reach the third communication fabric and the second port. According to the parent claim this configuration lacks antecedent basis because the second port is only limited to being connected to the fourth blade component via the fourth communication fabric. The examiner is assuming that this is the case. Thus the last 2 lines of the claim should read "the sixth communication fabric, the **fourth** blade component, the **fourth** communication fabric, and the second port."

10. As per claim 23, this claim has the same problems as claim 22. Examiner assumes that the last two lines should read "the seventh communication fabric, the **fourth** blade component, the **fourth** communication fabric, and the second port."

11. As per claim 27, this claim states that the first blade component is connected to the first connection fabric (lines 4 and 5) and that the second blade component is connected to the second connection fabric (lines 5 and 6). It then states that a path is configured to traverse from the host to the second communication fabric and then to the first blade component when the second blade component is inaccessible (last 2 lines). This lacks antecedent basis because the second communication fabric is not connected to the first blade component. The examiner instead assumes that the dynamically configured path traverses the host, the **second** communication fabric, and the first blade component when the second blade component is inaccessible.

12. As per claim 28, this claim furthers the incorrect connections of claim 27. The examiner is assuming that the **second** communication fabric is traversed by the path when the first blade component is inaccessible.

13. As per claims 42-45, these claims contain the same limitations as claims 20-23, and include the same antecedent basis issues as stated with claims 20-23. In each claim, the examiner is assuming that the newly configured path must traverse the third blade component to reach the third communication path to the first port, or it must traverse the fourth blade component to reach the fourth communication path to the second port.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. Claims 1, 3-5, 8-10, 13-15, 17, 24, 26-28, 31-32, 35-37, 39 and 47-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Idleman (US Patent 5,140,592) in view of Chai (US Patent 5,504,882).

15. As per claim 1, Idleman ('592) discloses a system for providing multi-path communications in a virtualization storage environment managing a virtual volume of data (column 3 lines 49-51, disk drives are virtualized), comprising:

a host system connected to first and second communication fabrics (as shown in Figure 4, the computer 10 is connected by links to both first level controllers 12A and 12B);

a network switch system connected to the first and second communication fabrics and to a third and fourth communication fabrics (as shown by Figure 4, this switch system includes both first level controllers 12A and 12B and second level controllers 14A and 14B and the inter-controller connections, the third and fourth

Art Unit: 2114

communication fabrics are the links between second level controller 14A and storage, and the links between second level controller 14B and storage); and

a set of storage devices storing virtual volume data and connected to the third and fourth storage communication fabrics (as shown in Figure 4, elements 20A1 through 20F13, also see column 8 lines 32-42),

Wherein the network switch system includes:

a second set of storage processors having access to the storage devices and maintaining virtual volume objects associated with logical partitions of the virtual volume data (column 28 lines 2-9 and lines 32-38),

wherein the first and second set of storage processors are interconnected by a fifth communication fabric (as shown by Figure 4, the numerous connections between first level controllers 12A and 12B and second level controllers 14A and 14B) and the network switch system provides fault tolerant access by the host system to the virtual volume data using one of a plurality of dynamically configurable multi-communication paths traversing selective combinations of the fabrics (as shown in figure 4, the different controllers use different inter-controller links, host-controller links, and controller-storage links), storage processors (column 6 lines 31-37), and storage devices (column 8 lines 29-31).

Idleman ('592) discloses the creation of a logical drive from multiple physical drives (column 3 lines 49-51) and that the second level controllers perform RAID controller

functions (column 28 lines 32-38) but does not expressly disclose the system wherein the first set of controllers maintain virtual volume objects reflecting a logical partition.

Chai ('882) discloses a hierarchical arrangement of storage controllers (see abstract) wherein the lower level storage controllers implement a virtual storage device (column 5 lines 45-52, and as emulated in column 6 lines 12-14).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the storage controllers disclosed by Idleman ('592) such that the controllers are used to emulate a virtualized storage device as taught by Chai ('882). This modification would have been obvious because it allows for the host to simply and efficiently use the storage controller (Chai ('882) column 6 lines 13-15) and to be tailored for the particular data processing system (column 6 lines 43-45).

16. As per claim 3, Idleman ('592) in view of Chai ('882) discloses the system of claim 1, wherein the network switch system dynamically configures a multi-communication path to provide access to the virtual volume data based on the availability of at least one of the first and second sets of storage processors (Idleman ('592) column 6 lines 30-34).

17. As per claim 4, Idleman ('592) in view of Chai ('882) discloses the system of claim 1, wherein the network switch system further includes:

a first blade component including a first subset of the first set storage processors (as shown by Figure 4, the first blade is first level controller 12a); and

a second blade component including a second subset of the first set of storage processors (as shown by Figure 4, the second blade is the first level controller 12b),

wherein the first blade component is attached to the first communication fabric and the fifth communication fabric (as shown by Figure 4, controller 12a is attached to the bus connecting it to the host computer (the first communication fabric) and has connections to both second level controllers via the fifth communication fabric) and the second blade component is attached to the second communication fabric and the fifth communication fabric (as shown by Idleman ('592), Figure 4, the first level controller 12b has a connection to the host computer (the second communication fabric) and has connections to both second level controllers as the fifth communication fabric).

18. As per claim 5, Idleman ('592) in view of Chai ('882) discloses the system of claim 4, wherein

when the second blade component is inaccessible by the host system the network switch system dynamically configures a first multi-communication path including the host system, the second (first) communication fabric, and the first blade component (Idleman ('592) column 8 lines 11-14, in the exemplary embodiment as shown by Figure 3, where first and second level controllers are paired, when either controller fails data is re-routed through the remaining controller pair), and

when the first blade component is inaccessible by the host system the network switch system dynamically configures a second multi-communication path including the host system, the first (second) communication fabric, and the first (second) blade component (Idleman ('592) column 8 lines 11-14, in the exemplary embodiment as shown by Figure 3, where first and second level controllers are paired, when either controller fails data is re-routed through the remaining controller pair).

19. As per claim 8, Idleman ('592) in view of Chai ('882) discloses the system of claim 4, wherein the network switch system further includes:

a third blade component including a first subset of the second set storage processors (as shown in Idleman ('592) figure 4, the third blade is the second level controller 14a); and

a fourth blade component including a second subset of the second set of storage processors (as shown in Idleman ('592) figure 4, the fourth blade is the second level controller 14b),

wherein the third blade component is attached to the third communication fabric and the fifth communication fabric (as shown in Idleman ('592) figure 4, second level controller 14a has a connection to both first level controllers and to the storage) and the fourth blade component is attached to the fourth communication fabric and the fifth communication fabric (as shown in Idleman ('592) figure 4, second level controller 14b has a connection to both first level controllers and a connection to the storage separate from the storage connection used by second level controller 14a).

20. As per claim 9, this claim recites the limitations recited in claim 8 and is rejected on the same grounds as claim 8.

21. As per claim 10, Idleman ('592) in view of Chai ('882) discloses the system of claim 9, wherein

when the third blade component is inaccessible, the network switch system dynamically configures a multi-communication path including at least the host system, at least one of the first and second communication fabrics, at least one of the first and second blade components, the fifth communication fabric, and the fourth blade component (Idleman ('592) column 10 lines 55-63, the functions of the failed second level controller are taken over by the remaining second level controller. And as shown by Idleman ('592) Figure 4, both first level controllers have connections to both second level controllers for such a controller failover. To be clear, the fifth communication fabric of Figure 4 is the four connections between the first level controllers and the second level controllers), and

when the fourth blade component is inaccessible, the network switch system dynamically configures a second multi-communication path including the at least the host system, at least one of the first and second communication fabrics, at least one of the first and second blade components, the fifth communication fabric, and the third blade component (Idleman ('592) column 10 lines 55-63, the functions of the failed second level controller are taken over by the remaining second level controller. And as

shown by Idleman ('592) Figure 4, both first level controllers have connections to both second level controllers for such a controller failover. To be clear, the fifth communication fabric of Figure 4 is the four connections between the first level controllers and the second level controllers).

22. As per claim 13, Idleman ('592) in view of Chai ('882) discloses the system of claim 1 wherein each of the storage devices includes a first port connected to the third communication fabric (as shown in Idleman ('592) Figure 4, each storage device, 20A1 through 20F13 contains a path to second level controller 14A through the third communication fabric) and a second port connected to the fourth communication fabric (as shown in Idleman ('592) Figure 4, each storage device, 20A1-20F13 has a path to second level controller 14b through the fourth communication fabric) and the network switch system dynamically configures a multi-communication path to include either one of the first and second ports of a given storage device when the given storage device includes virtual volume data referenced by the host system (column 8 line 64 through column 7 line 8, each controller has primary responsibility for a set of drives, and column 10 lines 48-51, upon a failure a dynamic switching is performed to reconfigure disk accesses to the storage formerly accessed by the now-failed second level controller to the partner second level controller).

23. As per claim 14, Idleman ('592) in view of Chai ('882) discloses the system of claim 13, wherein the network switch system dynamically configures a multi-

Art Unit: 2114

communication path to include the first port of the given storage device when the second port is unavailable and configures the multi-communication path to include the second port of the given storage device when the first port is unavailable (Idleman ('592) column 28 line 67 through column 29 line 1, the second level controllers are responsible for routing data from the first level controllers to storage memory, and column 28 lines 61-64, when a second controller is busy or failed it can be routed around using the alternate second level controller. As each second level controller has an associated, non-redundant storage port and fabric (as shown in Idleman ('592) figure 4 and in the discussion of claim 13), these elements are essential parts of a second level controller data path and a failure of any element breaks the path and requires a failover to maintain data communication between host computer and storage).

24. As per claims 15 and 17, these claims recite the same limitations as claim 13 and are rejected on the same grounds as claim 13.

25. As per claim 24, this claim recites limitations found in claim 1, with the additional limitation of the method including receiving a request from the host system to access the virtual volume data. Idleman ('592) column 8 lines 2-6 describe the host computer accessing disk drives and column 30 lines 56-57 refers to data accesses as data read requests.

26. As per claim 26, this claim recites limitations found in claim 3 and is rejected on the same grounds as claim 3.

27. As per claim 27, this claim recites limitations found in claim 4 (and claim 4's parent claims) and is rejected on the same grounds as claim 4.

28. As per claim 28, this claim recites limitations found in claim 5 and is rejected on the same grounds as claim 5.

29. As per claim 31, the first paragraph of this claim recites limitations found in claim 8. The second paragraph of claim 31 recites limitations found in claim 10. Claim 31 is rejected on the same grounds as supplied in claims 8 and 10.

30. As per claim 32, this claim recites limitations found in claims 10 and is rejected on the same grounds as claim 10.

31. As per claim 35 and 36, these claims recite limitations found in claims 13 and 14, respectively, and are rejected on the same grounds as claims 35 and 36.

32. As per claims 37 and 39, these claims recite limitations found in claim 13 and are rejected on the same grounds as claim 13.

Art Unit: 2114

33. As per claim 47, the first paragraph of this claim recites limitations found within claim 1. The last two paragraphs of claim 47 recite limitations found within claim 3. The new limitation of the method further including receiving a request from the host system to access the virtual volume data is disclosed by Idleman ('592). Idleman ('592) column 8 lines 2-6 describe the host computer accessing disk drives and column 30 lines 56-57 refers to data accesses as data read requests. Claim 47 is thus rejected on the same grounds as the same limitations of claims 1 and 3, and as further detailed within this paragraph.

34. As per claim 48, this claim recites limitations found within claim 47 and is rejected on the same grounds as claim 47.

35. Claims 6-7, 11-12, 19-23, 29-30, 33-34, and 41-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Idleman ('592) in view of Chai ('882) and in further view of Greig (US Patent 4,607,365).

36. As per claim 6, Idleman ('592) in view of Chai ('882) discloses the system of claim 5.

Idleman ('592) in view of Chai ('882) does not expressly disclose the system wherein the fifth communication fabric is a redundant communication fabric including a sixth and seventh communication fabrics, and wherein the network switch system dynamically

configures either one of the first and second multi-communication paths to include the sixth communication fabric when the fifth communication fabric is unavailable.

Greig ('365) teaches a system that includes (among other redundancies) redundant busses (column 2 lines 43-45) for failover (column 1 lines 32-36).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the two-level storage controller system disclosed by Idleman ('592) in view of Chai ('882) such that the links, as shown in Idleman ('592) Figure 4 that connect both first level controllers to both second level controllers are provided with a redundant backup connection for failover, as taught by Greig ('365). This modification would have been obvious because a bus error can disable communication between components and the use of redundant busses avoids this (Greig ('365) column 1 lines 25-35).

37. As per claim 7, Idleman ('592) in view of Chai ('882) discloses the system of claim 5.

Idleman ('592) in view of Chai ('882) does not expressly disclose the system wherein the fifth communication fabric is a redundant communication fabric including a sixth and seventh communication fabrics, and wherein the network switch system dynamically configures either one of the first and second multi-communication paths to include the seventh communication fabric when the sixth communication fabric is unavailable.

Greig ('365) teaches a system that includes (among other redundancies) redundant busses (column 2 lines 43-45) for failover (column 1 lines 32-36).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the two-level storage controller system disclosed by Idleman ('592) in view of Chai ('882) such that the links, as shown in Idleman ('592) Figure 4 that connect each first level controller to each second level controllers are provided with a redundant backup connection for failover, as taught by Greig ('365). This modification would have been obvious because a bus error can disable communication between components and the use of redundant busses avoids this (Greig ('365) column 1 lines 25-35).

38. As per claims 11-12, these claims recite the same limitations as claims 6-7, respectively, and are rejected on the same grounds as claims 6-7, respectively.

39. As per claim 19, Idleman ('592) in view of Chai ('882) discloses the system of claim 1, wherein the network switch system includes:

- a first blade component including a first subset of the first set of storage processors (as shown in Idleman ('592) figure 4, the first level controller 12a);

- a second blade component including a second subset of the first set of storage processors (Idleman ('592) figure 4, the first level controller 12b);

a third blade component including a first subset of the second set of storage processors (Idleman ('592) figure 4, the second level controller 14a);

a fourth blade component including a second subset of the second set of storage processors (Idleman ('592) figure 4, the second level controller 14b), and

wherein a first storage device includes a first port connected to the third communication fabric and a second port connected to the fourth communication fabric (as shown in Idleman ('592) figure 4, each storage 20A1-20F13 has a separate link to the second level controller 14a (the third fabric) and the second level controller 14b (the fourth fabric)).

Idleman ('592) in view of Chai ('882) does not explicitly disclose the system wherein the fifth communication fabric includes a sixth communication fabric and a seventh communication fabric each connected to the first through fourth blade components.

Greig ('365) teaches a system that includes (among other redundancies) redundant busses (column 2 lines 43-45) for failover (column 1 lines 32-36).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the two-level storage controller system disclosed by Idleman ('592) in view of Chai ('882) such that the links, as shown in Idleman ('592) Figure 4 that connect each first level controllers to each second level controllers are provided with a redundant backup connection for failover, as taught by Greig ('365). This modification would have

been obvious because a bus error can disable communication between components and the use of redundant busses avoids this (Greig ('365) column 1 lines 25-35).

40. As per claim 20, Idleman ('592) in view of Chai ('882) and Greig ('365) discloses the system of claim 19. Idleman ('592) in view of Chai ('882) and Greig ('365) does not expressly disclose the system, wherein when the seventh communication fabric and second port are unavailable, the network switch system dynamically configures a multi-communication path to traverse the host system, any one of the first and second communication fabrics, any one of the first and second blade components, the sixth communication fabric, any one of the third and fourth blade components, the third communication fabric, and the first port. (This claim is being interpreted as described in the 112 first paragraph rejection above.)

As discussed regarding claim 19, Greig ('365) teaches that when one of the redundant inter-controller busses fails, that a failover is performed to switch to the redundant bus. Thus when the seventh or seventh communication fabric is unavailable it would be obvious in view of Greig ('365) to failover to the remaining, un-failed bus.

As discussed regarding claim 14, when a storage port experiences a failure, it would be obvious, in view of Idleman ('592) to treat the port failure as a second level controller failure and failover to the alternate second level controller's data-path, including the associated third or fourth communication fabric and first or second port.

The separate inter-controller bus failover and controller/fabric/port path failover would both be obvious. And so to, in combination, the bus failover and second level controller path failover are both obvious remedies for their respective failures.

41. As per claim 21, Idleman ('592) in view of Chai ('882) and Greig ('365) discloses the system of claim 19.

Idleman ('592) in view of Chai ('882) and Greig ('365) does not explicitly disclose the system of claim 19, wherein when the sixth communication fabric and second port are unavailable, the network switch system dynamically configures a multi-communication path to traverse the host system, any one of the first and second communication fabrics, any one of the first and second blade components, the seventh communication fabric, any one of the third and fourth blade components, the third communication fabric, and the first port. (This claim is being interpreted as described in the 112 first paragraph rejection above.)

As discussed regarding claim 19, Greig ('365) teaches that when one of the redundant inter-controller busses fails, that a failover is performed to switch to the redundant bus. Thus when the seventh or seventh communication fabric is unavailable it would be obvious in view of Greig ('365) to failover to the remaining, un-failed bus.

Art Unit: 2114

As discussed regarding claim 14, when a storage port experiences a failure, it would be obvious, in view of Idleman ('592) to treat the port failure as a second level controller failure and failover to the alternate second level controller's data-path, including the associated third or fourth communication fabric and first or second port.

The separate inter-controller bus failover and controller/fabric/port path failover would both be obvious. And so to, in combination, the bus failover and second level controller path failover are both obvious remedies for their respective failures.

42. As per claim 22, Idleman ('592) in view of Chai ('882) and Greig ('365) discloses the system of claim 19.

Idleman ('592) in view of Chai ('882) and Greig ('365) does not explicitly disclose the system wherein when the seventh communication fabric and first port are unavailable, the network switch system dynamically configures a multi-communication path to traverse the host system, any one of the first and second communication fabrics, any one of the first and second blade components, the sixth communication fabric, any one of the third and fourth blade components, the third communication fabric, and the second port. (This claim is being interpreted as described in the 112 first paragraph rejection above.)

As discussed regarding claim 19, Greig ('365) teaches that when one of the redundant inter-controller busses fails, that a failover is performed to switch to the redundant bus. Thus when the seventh or seventh communication fabric is unavailable it would be obvious in view of Greig ('365) to failover to the remaining, un-failed bus.

As discussed regarding claim 14, when a storage port experiences a failure, it would be obvious, in view of Idleman ('592) to treat the port failure as a second level controller failure and failover to the alternate second level controller's data-path, including the associated third or fourth communication fabric and first or second port.

The separate inter-controller bus failover and controller/fabric/port path failover would both be obvious. And so to, in combination, the bus failover and second level controller path failover are both obvious remedies for their respective failures.

43. As per claim 23, Idleman ('592) in view of Chai ('882) and Greig ('365) discloses the system of claim 19.

Idleman ('592) in view of Chai ('882) and Greig ('365) does not explicitly disclose the system of claim 19, wherein when the sixth communication fabric and first port are unavailable, the network switch system dynamically configures a multi-communication path to traverse the host system, any one of the first and second communication fabrics, any one of the first and second blade components, the seventh communication fabric,

any one of the third and fourth blade components, the third communication fabric, and the second port. (This claim is being interpreted as described in the 112 first paragraph rejection above.)

As discussed regarding claim 19, Greig ('365) teaches that when one of the redundant inter-controller busses fails, that a failover is performed to switch to the redundant bus. Thus when the seventh or seventh communication fabric is unavailable it would be obvious in view of Greig ('365) to failover to the remaining, un-failed bus.

As discussed regarding claim 14, when a storage port experiences a failure, it would be obvious, in view of Idleman ('592) to treat the port failure as a second level controller failure and failover to the alternate second level controller's data-path, including the associated third or fourth communication fabric and first or second port.

The separate inter-controller bus failover and controller/fabric/port path failover would both be obvious. And so to, in combination, the bus failover and second level controller path failover are both obvious remedies for their respective failures.

44. As per claim 29 and 30, these claims recite limitations found in claim 6 and 7, respectively and are rejected on the same grounds as these respective claims.

45. As per claims 33 and 34, these claims recite limitations found in claims 6 and 7, respectively, and are rejected on the same grounds as claims 6 and 7.

46. As per claim 41, Idleman ('592) in view of Chai ('882) discloses the method of claim 24, wherein the network switch system includes a first blade component including a first subset of the first set storage processors (Idleman ('592) Figure 4, controller 12a is the first blade), a second blade component including a second subset of the first set storage processors (Idleman ('592) Figure 4, controller 12b is the second blade), a third blade component including a first subset of the second set storage processors (Idleman ('592) Figure 4, controller 14a is the third blade), and a fourth blade component including a second subset of the second set storage processors (Idleman ('592) Figure 4, controller 14b is the fourth blade), and wherein a first storage device includes a first port connected to the third communication fabric and a second port connected to the fourth communication fabric (Idleman ('592) Figure 4, the third fabric is the connection from second level controller 14a to the storage 20A1-20F13, and the fourth fabric is the connection from the second level controller 14b to the storage 20A1-20F13, these fabrics connect to the storage via different ports, as is depicted by one fabric connecting to the storage from the left and the other fabric connecting to the storage from the right).

Idleman ('592) does not expressly disclose the method wherein the fifth communication fabric includes a sixth communication fabric and a seventh communication fabric.

Greig ('365) teaches a system that includes (among other redundancies) redundant busses (column 2 lines 43-45) for failover (column 1 lines 32-36).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the two-level storage controller system disclosed by Idleman ('592) in view of Chai ('882) such that the links, as shown in Idleman ('592) Figure 4 that connect each first level controllers to each second level controllers are provided with a redundant backup connection for failover, as taught by Greig ('365). This modification would have been obvious because a bus error can disable communication between components and the use of redundant busses avoids this (Greig ('365) column 1 lines 25-35).

47. As per claim 42 and 43, these claims recite limitations found in claims 20 and 23, respectively, and are rejected on the same grounds as claims 20 and 23.

48. As per claims 44 and 45, these claims recite limitations found in claims 22 and 21, respectively, and are rejected on the same grounds as claims 22 and 21.

49. As per claim 46, Idleman ('592) discloses a method for providing multi-path communications in a storage virtualization environment including a multi-tiered network switch system (as shown in figure 4) that manages a virtual volume (column 3 lines 49-51) for a host system connected to the network switch system over a first and second path (as shown in Idleman ('592) figure 4, the host system has a connection to each first

Art Unit: 2114

level controller), wherein the network switch system includes a first layer (the first level controllers 12a and 12b), a set of storage devices connected to the first layer over third and fourth paths (as shown in Figure 4, the storage has a path to each second level controller 14a and 14b), and a second layer (second level controllers 14a and 14b), wherein the first and second virtualization layers are interconnected over a path (Figure 4, the links between first level controllers 12a and 12b and the second level controllers 14a and 14b), the method comprising:

receiving a request from the host system to access the virtual volume data (column 8 lines 2-6 describe the host computer accessing disk drives and column 30 lines 56-57 refers to data accesses as data read requests);

determining whether communications are available between at least one of:

the host system and the network switch system over the first or second paths (Idleman ('592) column 28 lines 61-64, a failure of the first or second controller can be routed around to maintain a path to storage using the alternate controller), the first layer and the second layer over the fifth, and the first layer and the storage devices over the third or fourth paths (Idleman ('592) column 28 lines 61-64, a failure of the first or second controller can be routed around to maintain a path to storage); and

providing access to the virtual volume data based on the determination (column 5 lines 22-27).

Art Unit: 2114

Idleman ('592) discloses a system wherein one level of controllers communicates data to a second level of controllers, and from the second level of controllers to the storage (as depicted in Figure 4). Idleman ('592) does not expressly disclose the system wherein each controller constitutes a virtualization layer.

Chai ('882) teaches a system wherein two levels of controllers are used to virtualize a storage using a hierarchy of RAID controllers (as shown in Figures 4 and 5 and column 5 lines 53-65).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the redundant storage controllers disclosed by Idleman ('592) such that the controllers provide for increased levels of data storage abstraction, as taught by Chai ('882). This modification would have been obvious because it allows different storage devices to be configured into a virtual storage device (Chai ('882) column 5 lines 5-8) for a predetermined level of tradeoff between reliability/redundancy and speed (Chai ('882) column 5 lines 16-19).

Idleman ('592) discloses the creation of a logical drive from multiple physical drives (column 3 lines 49-51) and that the second level controllers perform RAID controller functions (column 28 lines 32-38) but does not expressly disclose the system wherein the first set of controllers maintain virtual volume objects reflecting a logical partition.

Chai ('882) discloses a hierarchical arrangement of storage controllers (see abstract) wherein the lower level storage controllers implement a virtual storage device (column 5 lines 45-52, and as emulated in column 6 lines 12-14).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the storage controllers disclosed by Idleman ('592) such that the controllers are used to emulate a virtualized storage device as taught by Chai ('882). This modification would have been obvious because it allows for the host to simply and efficiently use the storage controller (Chai ('882) column 6 lines 13-15) and to be tailored for the particular data processing system (column 6 lines 43-45).

50. Claims 2, 16, 18, 25, 38 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Idleman ('592) in view of Chai ('882) and Sicola (US Patent 7,111,189).

51. As per claim 2, Idleman ('592) in view of Chai ('882) discloses the system of claim 1, wherein the network switch system dynamically configures a multi-communication path to provide access to the virtual volume data based on the availability of at least one of the storage processors (Idleman ('592) column 6 lines 30-34).

Idleman ('592) in view of Chai ('882) does not expressly disclose the system wherein the network switch system dynamically configures a multi-communication path to provide access to the virtual volume data based on the availability of at least one of the first through fifth communication fabrics.

Sicola ('189) teaches a redundant storage controllers system wherein link failure is detected and results in a controller failover (column 4 lines 47-59).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the redundant storage controller system disclosed by Idleman ('592) in view of Chai ('882) such that controller failover is performed when a controller fails, as disclosed by Idleman ('592) and when a link fails, as taught by Sicola ('189). This modification would have been obvious because it helps to minimize the possibility of an interruption of storage operations due to I/O failure (Sicola ('189) column 1 lines 36-40).

52. As per claim 16, Idleman ('592) in view of Chai ('882) discloses the system of claim 15, wherein the network switch system dynamically configures the multi-communication path to include the first port of the given storage device when the fourth communication fabric is unavailable and configures the multi-communication path to include the second port of the given storage device when the third communication fabric is unavailable (as shown in Idleman ('592) figure 4, second level controller 14a is connected to storage through a third communication fabric (the fabric on the left side of

Art Unit: 2114

storage) and through a first set of ports connecting the third fabric to storage. Second level controller 14b is connected to storage through a fourth communication fabric (the fabric on the right side of storage) and through a second set of ports connecting the fourth fabric to storage).

Idleman ('592) in view of Chai ('882) does not explicitly disclose that a second level controller failover occurs when a communication fabric is broken, busy or unavailable.

Sicola ('189) teaches a redundant storage controllers system wherein link failure is detected and results in a controller failover (column 4 lines 47-59).

At the time of invention it would have been obvious to a person of ordinary skill in the art to modify the redundant storage controller system disclosed by Idleman ('592) in view of Chai ('882) such that controller failover is performed when a controller fails, as disclosed by Idleman ('592) and when a link fails, as taught by Sicola ('189). This modification would have been obvious because it helps to minimize the possibility of an interruption of storage operations due to I/O failure (Sicola ('189) column 1 lines 36-40).

53. As per claims 18, 38 and 40, these claims recite limitations found in claim 16, and are rejected on the same grounds as claim 16.

Art Unit: 2114

54. As per claim 25, this claim recites limitations found in claim 2 and is rejected on the same grounds as claim 2.

Conclusion

The prior art made of record on accompanying PTO 892 form and not relied upon is considered pertinent to applicant's disclosure. Specifically, Meyer ('380) teaches the use of virtualization storage controllers within switch fabrics for redundant access, Chen ('910) teaches a virtualized storage system with redundant access available by NAS and SAN clients, Matsunami ('687) teaches redundant storage controller system for LAN and SAN use, and Kobayashi ('216) teaches a failover controller wherein a path group table is stored to record the path to storage being employed.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Schell whose telephone number is (571) 272-8186. The examiner can normally be reached on Monday through Friday 9AM-4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Scott Baderman can be reached on (571) 272-3644. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JS



SCOTT BADERMAN
SUPERVISORY PATENT EXAMINER